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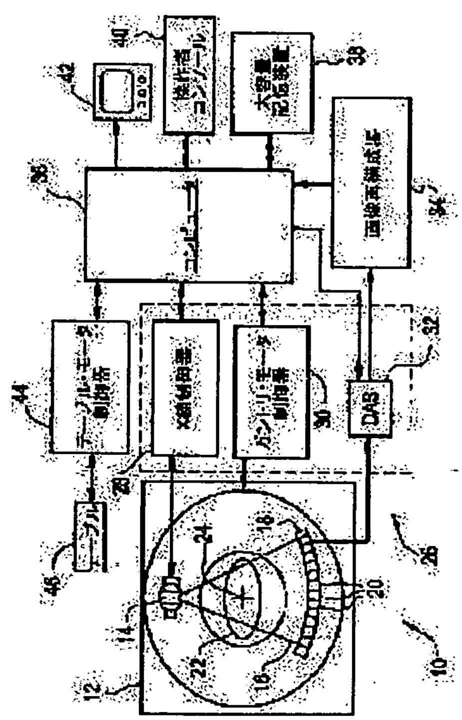
(54) METHOD AND APPARATUS FOR CORRECTING CONE-BEAM MULTI- SLICE TYPE CT

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the image quality and practicality in multi-slice type computerized tomography(CT) imaging.

SOLUTION: The method comprises a process of moving an X-ray source along the orbit, a process of irradiating an x-ray cone beam from the moving X-ray source toward a curved detector through an object, and a process of determining the portion of a segment along the orbit to be contributed to a boxel in the restructured volume of the object. The process of determining the portion to be contributed includes compensation of the portion to be contributed in the curvature of the detector and the shape of the X-ray cone beam.



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CLAIMS

[Claim(s)]
[Claim 1] The process to which it is the multi-slice type calculating-machine type tomography imaging approach, and X line source is moved in accordance with an orbit, The process which projects an X-ray cone beam toward the detector which curved through the body from this X line source which moves, How to be the process which determines each amount contributed of two or more segments in alignment with said orbit over the voxel in the reconstruction volume of said body, and to have the process including compensating the this determined amount contributed about the curvature of said detector, and the configuration of an X-ray cone beam.
[Claim 2] Furthermore, said process which determines the amount contributed of the segment in alignment with said orbit over the voxel in the reconstruction volume of said body is an approach including the process which carries out filtering and which carries out back projection using the double integral about a fan include angle and a line source include angle about each point in said reconstruction volume according to claim 1.
[Claim 3] Said process which carries out back projection using double integral is an approach including the process which performs back projection on a polar-coordinate reconstruction grid according to claim 2.
[Claim 4] Said process which said detector which curved is a cylindrical shape detector, and compensates said determined amount contributed about the curvature of said detector and the configuration of an X-ray cone beam is an approach including the process which compensates said determined amount contributed about the curvature of said cylindrical shape detector according to claim 1.
[Claim 5] Said process to which X line source is moved in accordance with an orbit is an approach including the process to which said X line source is moved in accordance with the spiral orbit over said body according to claim 1.
[Claim 6] The process to which X line source is moved in accordance with an orbit, the process which projects an X-ray cone beam toward the detector which curved through the body from X line source which this moves, and in order to form a fault image The process which the signal showing the detected X-ray which passed said body is weighted, carries out filter processing, and is performed in three-dimension space while it is the process which carries out back projection and said back projection performs compensation about the X-ray cone shape of beam, The multi-slice type calculating-machine type tomography imaging approach of ****(ing).
[Claim 7] Said process which carries out back projection using the signal showing the detected X-ray is an approach including the process which carries out back projection on a polar-coordinate reconstruction grid according to claim 6.
[Claim 8] It is the approach according to claim 6 by which said process to weight is performed in front of said process which carries out filtering, and said process which carries out filtering is performed in front of said process which carries out back projection.
[Claim 9] Said process which weights, carries out filtering of the signal with which the detected X-ray

which passed said body is expressed in order to form a fault image, and carries out back projection is [Equation 1].

$$f(\mathrm{v}) = \int_0^{\pi+2\Gamma} \frac{S}{L^2(\mathrm{v},\beta)} \left[g \otimes \left(p^* \times HSW(\beta,\gamma)\right)\right]\left(\gamma \;;\xi',\beta\right) \frac{\cos^{3/2}(\gamma\cos\alpha)\, d\beta}{\left(\cos^2\gamma + \sin^2\gamma\cos^2\alpha\right)^{3/2}}$$

** -- the process which determines reconstruction image function f (v) written like -- containing -- **** -- here -- [External Character 1]
⊗は畳み込みを表わしており、

S is the distance from a line source to an isocenter, and v is the voxel in cylindrical coordinates (r, psi, kappa). xi'=xi' (v, beta) is the height of the direction of z about the projection to the detector of v. L is the distance (in three-dimension space) from the voxel to a line source, and g() shows the fan beam reconstruction convolution kernel. p* Are data after interpolating on the dip flat surface, and HSW() shows the half scan load. It is the approach according to claim 8 gamma is a fan include angle, beta is a line source include angle, alpha is an include angle between the level surface and said dip flat surface, and gamma is the maximum fan include angle of said fan beam.
[Claim 10]
[Equation 2]

$$g(\gamma-\tilde{\gamma}) = \left(\frac{\gamma-\tilde{\gamma}}{\sin(\eta(\gamma)-\eta(\tilde{\gamma}))}\right)^2 h(\gamma-\tilde{\gamma}) \approx A(\gamma)K(\gamma-\tilde{\gamma})h(\gamma-\tilde{\gamma})B(\tilde{\gamma});$$

Come out, it is, h() is a parallel kernel here, and A, B, and K are [Equation 3].

$$A(\gamma) = \frac{1+\cos^2\alpha\ \tan^2\gamma}{1+\tan^2\gamma};$$

$$B(\tilde{\gamma}) = \frac{1+\cos^2\alpha\ \tan^2\tilde{\gamma}}{1+\tan^2\tilde{\gamma}};$$

$$K(\gamma-\tilde{\gamma}) = \frac{1+\tan^2(\gamma-\tilde{\gamma})}{1+\cos^2\alpha\tan^2(\gamma-\tilde{\gamma})} \times \left(\frac{\gamma-\tilde{\gamma}}{\sin\{a\tan[\cos\alpha\tan(\gamma-\tilde{\gamma})]\}}\right)^2;$$

It is written and is eta(gamma) =arctan [(cos alpha) xtan (gamma)].
Come out, and it is and is [External Character 2].
ここで、$\tilde{\gamma}$は再構成されているボクセルを通過する射線のファン角度である、

An approach according to claim 9.
[Claim 11] Said process to which said X line source is moved in accordance with an orbit is an approach including the process to which said X line source is moved in the spiral orbit over said body according to claim 6.
[Claim 12] Said process which projects an X-ray cone beam toward the detector which curved through said X line source which moves to the body is an approach including the process which projects said X-ray cone beam toward a cylindrical shape detector through said X line source which moves to a body according to claim 6.
[Claim 13] Said process which weights, carries out filtering of the signal with which the detected X-ray which passed said body is expressed so that a fault image may be formed, and carries out back projection is [Equation 4].

$$f(r,\phi,\kappa)=\int_{0}^{2\pi+B}\int_{-\Gamma}^{\Gamma}\frac{S}{L^2+\kappa^2}\frac{1\times SW(\beta,\gamma)}{\cos(\alpha)}g(\gamma-\tilde{\gamma})p^*(\beta,\gamma,\xi')\cos(\gamma\cos(\alpha))d\gamma d\beta$$

The process which determines reconstruction image function f(v) =f (r, phi, kappa) written like is included. ** -- here B shows the overscan include angle and SW (beta, gamma) shows the element of the group which consists of an overscan load function and an under scan load function. S is the distance from a line source to an isocenter, and v is the voxel in cylindrical coordinates (r, psi, kappa). xi'=xi' (v, beta) is the height of the direction of z about the projection to the detector of v. L is the distance (in three-dimension space) from the voxel to a line source, g() shows the fan beam reconstruction convolution kernel, and it is p*. It is data after interpolating on the dip flat surface, gamma is a fan include angle, and it is [External Character 3].
$\tilde{\gamma}$は再構成されているボクセルを通過する射線のファン角度であり、

It is the approach according to claim 6 beta is a line source include angle, alpha is an include angle between the level surface and said dip flat surface, and gamma is the maximum fan include angle of said fan beam.
[Claim 14]
[Equation 5]

$$g(\gamma-\tilde{\gamma})=\left(\frac{\gamma-\tilde{\gamma}}{\sin(\eta(\gamma)-\eta(\tilde{\gamma}))}\right)^2 h(\gamma-\tilde{\gamma})\approx A(\gamma)K(\gamma-\tilde{\gamma})h(\gamma-\tilde{\gamma})B(\tilde{\gamma});$$

Come out, it is, h() is a parallel kernel here, and A, B, and K are [Equation 6].

$$A(\gamma)=\frac{1+\cos^2\alpha\ \tan^2\gamma}{1+\tan^2\gamma};$$

$$B(\tilde{\gamma})=\frac{1+\cos^2\alpha\ \tan^2\tilde{\gamma}}{1+\tan^2\tilde{\gamma}};$$

$$K(\gamma-\tilde{\gamma})=\frac{1+\tan^2(\gamma-\tilde{\gamma})}{1+\cos^2\alpha\tan^2(\gamma-\tilde{\gamma})}\times\left(\frac{\gamma-\tilde{\gamma}}{\sin\{a\tan[\cos\alpha\tan(\gamma-\tilde{\gamma})]\}}\right)^2;$$

It is written and is eta(gamma) =arctan [(cos alpha) xtan (gamma)].
It comes out and is a certain approach according to claim 13.
[Claim 15] Said SW (beta, gamma) is an approach according to claim 13 by which it is an under scan load function, said process to weight is performed in front of said process which carries out filtering, and said process which carries out filtering is performed in front of said process which carries out back projection.
[Claim 16] Said SW (beta, gamma) is an approach according to claim 13 by which it is an overscan load function, said process which carries out filtering is performed in front of said process to weight, and said process to weight is performed in front of said process which carries out back projection.
[Claim 17] It is the approach according to claim 6 by which said process to weight is performed in front of said process which carries out filtering, and said process which carries out filtering is performed in front of said process which carries out back projection.
[Claim 18] It is the multi-slice type calculating-machine type (tomography CT) imaging system equipped with movable X line source and the detector which curved. An X-ray cone beam is projected toward said detector which curved through a body from X line source which is made to move said X line source in accordance with an orbit, and this moves. Each amount contributed of two or more segments

in alignment with said orbit over the voxel in the reconstruction volume of said body is determined. The multi-slice type calculating-machine type tomography imaging system constituted so that the determined this amount contributed may be compensated about the curvature of said detector, and the configuration of an X-ray cone beam.

[Claim 19] Furthermore, said system be a multi-slice type calculating machine type tomography imaging system according to claim 18 constitute so that the double integral about a fan include angle and a line source include angle may be use, filter processing may be carry out and back projection may be carry out about each point in said reconstruction volume, in order to determine the amount contributed of the segment in alignment with said orbit over the voxel in the reconstruction volume of said body.

[Claim 20] Said system is a multi-slice type calculating-machine type tomography imaging system according to claim 19 constituted so that back projection may be carried out on a polar-coordinate reconstruction grid in order to carry out back projection using double integral.

[Claim 21] It is the multi-slice type calculating-machine type tomography imaging system according to claim 18 constituted so that said detector is a cylindrical shape detector, and said determined amount contributed may be compensated about the curvature of said cylindrical shape detector, in order that said system may compensate said determined amount contributed about the curvature of said detector, and the configuration of an X-ray cone beam.

[Claim 22] Said system is a multi-slice type calculating-machine type tomography imaging system according to claim 18 constituted so that said X line source may be moved in accordance with the spiral orbit over said body in order to move said X line source in accordance with an orbit.

[Claim 23] It is the multi-slice type calculating-machine type (tomography CT) imaging system equipped with movable X line source and the detector which curved. In order to project an X-ray cone beam toward the detector which curved through the body from X line source which is made to move X line source in accordance with an orbit, and this moves and to form a fault image Weight the signal showing the detected X-ray which passed said body, carry out filtering, and it is constituted so that back projection may be carried out. Furthermore, the multi-slice type calculating-machine type tomography imaging system constituted so that back projection may be carried out in three-dimension space, performing compensation about the X-ray cone shape of beam.

[Claim 24] Said system is a multi-slice type calculating-machine type tomography imaging system according to claim 23 constituted so that back projection may be carried out on a polar-coordinate reconstruction grid in order to carry out back projection using the signal showing the detected X-ray.

[Claim 25] The multi-slice type calculating-machine type tomography imaging system according to claim 23 constituted so that said signal may be weighted before carrying out filtering of said signal, and filter processing of said signal may be carried out before said back projection.

[Claim 26] Said system is [Equation 7], in order to weight, to carry out filtering of the signal showing the detected X-ray which passed said body and to carry out back projection so that a fault image may be formed.

$$f(\mathrm{v})=\int_{0}^{\pi+2\Gamma}\frac{S}{L^{2}(\mathrm{v},\beta)}\left[g\otimes\left(p^{*}\times HSW(\beta,\gamma)\right)\right](\gamma\ ;\xi',\beta)\frac{\cos^{3/2}(\gamma\cos\alpha)\,d\beta}{\left(\cos^{2}\gamma+\sin^{2}\gamma\cos^{2}\alpha\right)^{3/2}}$$

** -- it constitutes so that reconstruction image function f (v) written like may be determined -- having -- **** -- here -- [External Character 4]
⊗は畳み込みを表わしており、

S is the distance from a line source to an isocenter, and v is the voxel in cylindrical coordinates (r, psi, kappa). xi'=xi' (v, beta) is the height of the direction of z about the projection to the detector of v. L is the distance (in three-dimension space) from the voxel to a line source, and g() shows the fan beam reconstruction convolution kernel. p* Are data after interpolating on the dip flat surface, and HSW() shows the half scan load. It is the multi-slice type calculating-machine type tomography imaging system according to claim 25 whose beta gamma is a fan include angle and is a line source include angle, whose alpha is an include angle between the level surface and said dip flat surface and whose gamma is the

maximum fan include angle of said fan beam.
[Claim 27]
[Equation 8]

$$g(\gamma-\tilde{\gamma})=\left(\frac{\gamma-\tilde{\gamma}}{\sin(\eta(\gamma)-\eta(\tilde{\gamma}))}\right)^2 h(\gamma-\tilde{\gamma})\approx A(\gamma)K(\gamma-\tilde{\gamma})h(\gamma-\tilde{\gamma})B(\tilde{\gamma});$$

Come out, it is, h() is a parallel kernel here, and A, B, and K are [Equation 9].

$$A(\gamma)=\frac{1+\cos^2\alpha\ \tan^2\gamma}{1+\tan^2\gamma};$$

$$B(\tilde{\gamma})=\frac{1+\cos^2\alpha\ \tan^2\tilde{\gamma}}{1+\tan^2\tilde{\gamma}};$$

$$K(\gamma-\tilde{\gamma})=\frac{1+\tan^2(\gamma-\tilde{\gamma})}{1+\cos^2\alpha\tan^2(\gamma-\tilde{\gamma})}\times\left(\frac{\gamma-\tilde{\gamma}}{\sin\{a\tan[\cos\alpha\tan(\gamma-\tilde{\gamma})]\}}\right)^2;$$

It is written and is eta(gamma) =arctan [(cos alpha) xtan (gamma)].
Come out, and it is and is [External Character 5].
ここで、$\tilde{\gamma}$は再構成されているボクセルを通過する射線のファン角度である、

An approach according to claim 26.
[Claim 28] Said system is a multi-slice type calculating-machine type tomography imaging system according to claim 23 constituted so that said X line source may be moved in the spiral orbit over said body in order to move said X line source in accordance with an orbit.
[Claim 29] Said detector which curved is a multi-slice type calculating-machine type tomography imaging system according to claim 23 which is a cylindrical shape detector.
[Claim 30] Said system is [Equation 10], in order to weight, to carry out filtering of the signal showing the detected X-ray which passed said body and to carry out back projection so that a fault image may be formed.

$$f(r,\phi,\kappa)=\int_0^{2\pi+B}\int_{-\Gamma}^{\Gamma}\frac{S}{L^2+\kappa^2}\frac{1\times SW(\beta,\gamma)}{\cos(\alpha)}g(\gamma-\tilde{\gamma})p^*(\beta,\gamma,\xi')\cos(\gamma\cos(\alpha))d\gamma d\beta$$

It is constituted so that reconstruction image function f(v) =f (r, phi, kappa) written like may be determined. ** -- here B shows the overscan include angle and SW (beta, gamma) shows the element of the group which consists of an overscan load function and an under scan load function. S is the distance from a line source to an isocenter, and v is the voxel in cylindrical coordinates (r, psi, kappa). xi'=xi' (v, beta) is the height of the direction of z about the projection to the detector of v. L is the distance (in three-dimension space) from the voxel to a line source, it is data after g() shows the fan beam reconstruction convolution kernel and p* was interpolated on the dip flat surface, gamma is a fan include angle, and it is [External Character 6].
$\tilde{\gamma}$は再構成されているボクセルを通過する射線のファン角度であり、

It is the multi-slice type calculating-machine type tomography imaging system according to claim 23 whose beta is a line source include angle, whose alpha is an include angle between the level surface and said dip flat surface and whose gamma is the maximum fan include angle of said fan beam.
[Claim 31]
[Equation 11]

$$g(\gamma-\tilde{\gamma})=\left(\frac{\gamma-\tilde{\gamma}}{\sin(\eta(\gamma)-\eta(\tilde{\gamma}))}\right)^2 h(\gamma-\tilde{\gamma})\approx A(\gamma)K(\gamma-\tilde{\gamma})h(\gamma-\tilde{\gamma})B(\tilde{\gamma});$$

Come out, it is, h() is a parallel kernel here, and A, B, and K are [Equation 12].

$$A(\gamma)=\frac{1+\cos^2\alpha\ \tan^2\gamma}{1+\tan^2\gamma};$$

$$B(\tilde{\gamma})=\frac{1+\cos^2\alpha\ \tan^2\tilde{\gamma}}{1+\tan^2\tilde{\gamma}};$$

$$K(\gamma-\tilde{\gamma})=\frac{1+\tan^2(\gamma-\tilde{\gamma})}{1+\cos^2\alpha\tan^2(\gamma-\tilde{\gamma})}\times\left(\frac{\gamma-\tilde{\gamma}}{\sin\{a\tan[\cos\alpha\tan(\gamma-\tilde{\gamma})]\}}\right)^2;$$

It is written and is eta(gamma) =arctan [(cos alpha) xtan (gamma)].
It comes out and is a certain system according to claim 30.
[Claim 32] Said SW (beta, gamma) is a multi-slice type calculating-machine type tomography imaging system according to claim 30 constituted so that it may be an under scan load function, said load may be performed before said filtering and said filter processing may be performed before said back projection.
[Claim 33] Said SW (beta, gamma) is a multi-slice type calculating-machine type tomography imaging system according to claim 30 constituted so that it may be an overscan load function, said filtering may be performed before said load and said load may be performed before said back projection.
[Claim 34] The multi-slice type calculating-machine type tomography imaging system according to claim 23 constituted so that said load may be performed before said filtering and said filter processing may be performed before said back projection.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Generally more specifically, this invention relates to the cone beam (cone beam) amendment for reconfigurating the imaging data of three-dimension calculating-machine type tomography about the approach and equipment for reconfigurating imaging (image creation) data.
[0002]
[Background of the Invention] In at least one well-known configuration of the calculating-machine type (tomography CT) imaging system, X line source projects the beam of a fan (sector) configuration, and this beam is XY flat surface of a Cartesian coordinate system, and it is collimated so that it may be located in the flat surface generally called a "imaging flat surface." An X-ray beam passes imaging ********** bodies, such as a patient. After a beam decreases with a body, incidence of it is carried out to the array (array) of a radiation detector. It depends on the amount of decrease of the X-ray beam by the body for the reinforcement of the beam radiation which is received in the place of a detector array and which decreased. The separate electrical signal each detector component of whose in an array is the measured value of the beam decrease in the location of a detector is generated. The decrease measured value from all detectors is acquired separately, and forms a transparency profile.
[0003] In a well-known third generation CT system, X line source and a detector array revolve around a imaging ********** body with a gantry in a imaging flat surface so that the include angle to which an X-ray beam intersects a body may change regularly. a group from the detector array in one gantry include angle -- X-ray decrease measured value, i.e., projection data, is called "a view (view)." The objective "the scan (scan)" consists of 1 set of views formed in various gantry include angles, i.e., a view include angle, while X line source and a detector rotate one time. In an AKISHARU scan (shaft-orientations scan), projection data is processed, and the image corresponding to the two-dimensional slice obtained through a body is constituted in it. the one approach of reconfigurating an image from 1 set of projection data -- this industry -- filtered back-projection (filtered backprojection) -- it is called law. This technique changes the decrease measured value from a scan into the integer called "CT number" or a "HANSU field (Hounsfield) unit", and controls the brightness of the pixel to which it corresponds on a cathode-ray tube drop using these integers.
[0004] "A cone include angle, i.e., the three-dimensional inner capacity of measurement data," is very small in at least one well-known multi-slice type CT system. Therefore, now, this system is processing three-dimension data using a two-dimensional algorithm. By using the Feldkamp (FDK) algorithm which is the simple perturbation of the two-dimensional filtered back-projection (FBP) algorithm for image reconstruction, the outstanding image quality is acquired about these comparatively small cone include angles. However, the cone beam artifact of a FDK algorithm increases while a cone include angle increases as it is not exact and the number of slices (in the case of the fixed slice thickness) increases.
[0005] It is desirable to extend a two-dimensional CT fan beam reconstruction algorithm to the cone shape of beam of a third generation multi-slice type CT imaging system. Although such reconstruction is based on the corrected FDK algorithm, correction must compensate both the area mold detector of a cylindrical shape (not being a plan type), and (not circular) the line source orbit of a screw type. When the detector array which curved is used, application of a new data filter, a front [convolution] load, and the load after convolution is needed for the data interpolation and list in alignment with the curve on a detector. However, since adjustable data (projection ray) redundancy conditions arise over the whole image reconfigurated by the line source orbit of a screw type, the back projection of voxel actuation is complicated. It is necessary to compute the ray which passes the voxel with X line source as the starting point about each voxel in reconstruction volume (volume) for every line source location. Therefore, the approach coping with the handling of data redundancy and the handling of the ray of the adjustable number which carries out the amount contributed to the voxel must be found out.
[0006] Two approaches coping with the problem of data redundancy and the problem of the ray of the

adjustable number which carries out the amount contributed to the voxel are well-known. In one approach, a spiral pitch is restricted so that at least two samples (it interpolated) may be obtained about each voxel. Only projection for 2pi is held and superfluous data are canceled. z resolving power obtained from a conjugation ray is disregarded in order to keep approach simple. However, in a patient's scan, since this approach increases quantity of radiation while restricting the imaging range of a patient remarkably, it is impractical. The 2nd approach improves the 1st approach by reducing the dosage to a patient while making image quality (IQ) good relatively, treating the practical pitch of arbitration. However, the approach which embodied this approach coping with an above-mentioned problem requires that all the data that pass the given voxel should be available simultaneous (a given line source include angle and fan include angle). As a result, the approach based on the 2nd approach is impractical, and cannot be embodied.

[0007] Therefore, it is desirable to offer the approach and equipment which maintained balance permissible between improvement in image quality and practicability in the third generation CT imaging system.

[0008]

[Summary of the Invention] Therefore, in the one example, the multi-slice type calculating-machine type tomography imaging approach is offered. The process to which this approach moves X line source in accordance with an orbit, and the process which projects an X-ray cone beam toward the detector which curved through the body from X line source to which it moves, The process which determines the amount contributed of the segment in alignment with the above-mentioned orbit over the voxel in objective reconstruction volume is included, and the process to determine includes compensating the determined amount contributed about the curvature of a detector, and the configuration of an X-ray cone beam.

[0009] An above-mentioned example and the example of others which are explained in full detail here offer the image quality which improved also about the cylindrical shape detector and the spiral line source orbit in a third generation CT imaging system. in addition, these examples -- CT imaging -- it can embody within the limits of a limit of the constraint about the practicability imposed by the hardware of business, and the dosage to a patient.

[0010]

[Detailed explanation of invention] The calculating-machine type (tomography CT) imaging system 10 is shown in drawing 1 and drawing 2 as what contains the typical gantry 12 in the "third generation" CT scanner. The gantry 12 has the X line source 14, and the X line source 14 projects X-ray beam 16 toward the detector array 18 prepared in the side which a gantry 12 counters. The detector array 18 is formed of the detector component 20, and the detector component 20 is a package and it detects the X-ray which passes a body 22, for example, a patient, and on which it was projected. The detector array 18 may be produced as a single slice (single slice) type configuration, and may be produced as a multi-slice (many slices) type configuration. Each detector component 20 expresses the reinforcement of the X-ray beam which carries out incidence, therefore while passing a patient 22, it generates the electrical signal showing decrease of a beam. The component part with which the gantry 12 and the gantry 12 are equipped among one scan for acquiring X-ray projection data revolves around a center of rotation 24.

[0011] The revolution of a gantry 12 and actuation of the X line source 14 are controlled by the controlling mechanism 26 of the CT system 10. The controlling mechanism 26 contains the X-ray controller 28 and the gantry motor controller 30. The X-ray controller 28 supplies a power signal and a timing signal to the X line source 14, and the gantry motor controller 30 controls the rotational speed and the location of a gantry 12. The data acquisition system (DAS) 32 established in the controlling mechanism 26 samples the analog data from the detector component 20, and changes this data into a digital signal for consecutive processing. The X-ray data by which the image reconstruction machine 34 was sampled and digitized are received from DAS32, and high-speed image reconstruction is performed. The reconfigurated image is impressed as an input to a computer 36, and a computer 36 stores an image in large capacity storage 38.

[0012] A computer 36 receives a command (instruction) and the parameter for a scan from an operator

again through the console 40 which has a keyboard. With the cathode-ray tube drop 42 attached, an operator can observe the reconfigurated image and the data of others from a computer 36. The command and parameter which the operator supplied are used by computer 36, and supply a control signal and information to DAS32, the X-ray controller 28, and the gantry motor controller 30. In addition, a computer 36 operates the table motor controller 44 which controls the motor type table 46, and stations a patient 22 within a gantry 12. Specifically, a table 46 moves a patient's 22 each part through the gantry opening 48.
[0013] In the one example of this invention, the two-dimensional CT fan beam reconstruction approach is extended to the cone shape of beam in the third generation multi-slice type CT. Not a circular line source orbit but the line source orbit of a screw type is used, using not the area mold detector of a plan type but the detector of a cylindrical shape which curved. The detector array which curved generates data, and data are interpolated along with the curve of a detector by consecutive processing, and they carry out filtering of the interpolated data, collapsing using a data filter and using a front load and the load after convolution. By the line source orbit of a screw type, adjustable data (projection ray) redundancy conditions arise over the whole reconstruction image of the back projection of voxel actuation. Therefore, the ray which passes each voxel with X line source as the starting point about each view of reconstruction volume is computed. The configuration of the example of 4 slice system of the third generation is typically shown in drawing 3 . A gantry 12 revolves around the z-axis 50. The front face 52 of a detector 18 is located on a cylinder, is equipped with four lines, and each line has 888 detector components 20. Although line data are equivalent to the ray 54, these rays 54 are not located in a level reconstruction flat surface. "Cone include-angle" 56 to a gantry flat surface (the gantry flat surface itself is defined as a flat surface which is a flat surface which includes the point of a line source 14 and bisects the cylinder of a detector 18, and intersects perpendicularly with the z-axis) express the degree of the mismatching in the cone beam data at the time of comparing with two-dimensional CT data. The flat surface including a focal spot or a focus 58 intersects the detector front face 52 along with the radii 60 decreased according to cos (gamma). Since incidence of the ray 62 which passes along the voxel V1 is carried out to the detector array 18, the data showing the voxel V1 are presumed by interpolation. However, since incidence of the ray 64 which passes along the voxel V2 is not carried out to the detector array 18, the data showing the voxel V2 are presumed by the extrapolation.
[0014] In the one example, while dealing with data redundancy conditions combining the load approaches, such as a half scan, an under scan, and an overscan, in the back projection of voxel actuation, the extrapolation of data, and a list, improvement in image quality and practicability are balanced by graduating the discontinuity in the interface of the line source include angle of 0 and 2pi about a spiral orbit. Utilization of an extrapolation enables it to use a high scanning pitch by guaranteeing canceling no measured value, while a fixed number of projection measured value is offered [location / given / line source] about all voxel. Thus, the adjustable voxel sampling of the line source location relevant to a cone include angle and a detector dimension is eliminated by the extrapolation. The inconsistency of the data produced from the combination of a cone include angle and a spiral scan (helical scan) is managed using the data redundancy relevant to a line source, and the gradual decrease load (the half scan load in a high-speed (HS) pitch, the overscan load in a high-definition (HQ) pitch, or under scan load) applied by accompanying. In order to enable independent projection processing, HS pitch and HQ pitch are computed so that at least one ray or two rays may carry out the amount contributed to the given voxel, respectively.
[0015] In the one example, a Feldkamp (FDK) reconstruction algorithm is corrected so that it may use for a third generation multi-slice type CT imaging system. FDK is the perturbation of two-dimensional filtered back-projection (FBP), and computes the double integral about the fan include angle gamma and the line source include angle beta for every point of the image reconfigurated. In FDK, it is computed by the amount contributed of each infinitesimal segment in alignment with the line source orbit over the voxel in reconstruction volume being whether ** has also contributed to two-dimensional reconstruction in the flat surface where this segment is demarcated by this infinitesimal segment and the point, i.e., the voxel, and making. therefore, FDK -- two-dimensional -- it is drawn from FBP by modification of a

variable. If drawing 4 is described with reference to Voxel V, S is the distance from a line source 14 to an isocenter 82, S+D is the distance from a line source 14 to a detector 18, beta is a line source include angle, and it is betat. It is a line source include angle in a dip flat surface, gamma is a fan include angle, and it is gammat. It is a fan include angle in a dip flat surface, and alpha is an include angle between the level surface and a dip flat surface. Moreover, [0016]
[External Character 7]
$\vec{r}$は半径方向ベクトルであり、$\vec{r}'$は考察している傾斜平面（すなわち、ガントリ平面に対して傾斜している）における半径方向ベクトルである。

[0017] It does not need to be interpolated of the example using a flat panel mold X-ray detector on the radii of cos (gamma). That is, the filter processing in alignment with the line of a detector becomes filtering and equivalence of data which are located in the same flat surface about these panels [like]. Therefore, modification of the above-mentioned variable differs a little in the example which used the flat panel mold X-ray detector.
[0018] After interpolation of the projection data on a plane set, it is a projection ray. St dbetat=S dbeta tan gamma t=tan gamma cos alpha (1)
It is distributed over the interior of a fan according to the fan beam parameter expression written.
[0019]
[External Character 8]
ここで、γ'は傾斜平面におけるファン角度を表わし、$d\beta'$は、図4に示すような$\vec{r}'$によって示されている傾斜平面における無限小の円弧長を表わす。

[0020] It follows. cos gammat dgammat =(cos alpha dgamma)/(cos2 gamma+cos 2alpha cos2gamma) 3/2 (2)
It becomes.
[0021] Therefore, if a formula (1) and a formula (2) are substituted for a two-dimensional FBP reconstruction type, the example which embodied FDK to accuracy on the third generation CT imaging system will be acquired.
[0022] approximation -- real number transition change (shift-variant) transition which approaches extremely and approximates a mold filter -- it is eternal (shift-invariant) Although the example of a mold filter is acquired, this example is relatively simple and suits the convolution in the fourier field easily relatively. One example of the reconstruction algorithm of this invention using a transition change mold filter exact about FDK and its transition eternal mold approximation are described below.
[0023] The third generation FDK fan beam parameter expression in a dip flat surface is given by the following formula (3).
[0024]
eta(gammat) =arctan [(cos alpha) xtan (gammat)] (3)

[0025] The transition eternal mold approximation to a transition change mold kernel is written as follows (superscript t is excluded and written).
[0026]
[Equation 13]

$$\sin[\eta(\gamma)-\eta(\tilde{\gamma})] \approx \left[\frac{\eta'(\gamma)\eta'(\tilde{\gamma})}{\eta'(0)\eta(\gamma-\tilde{\gamma})}\right]^{1/2} \sin[\eta(\gamma-\tilde{\gamma})]. \qquad (4)$$

[0027] Therefore, the following formula is written by replacing eta of the upper formula (4).
[0028]
[Equation 14]

$$g(\gamma-\tilde{\gamma})=\left(\frac{\gamma-\tilde{\gamma}}{\sin(\eta(\gamma)-\eta(\tilde{\gamma}))}\right)^2 h(\gamma-\tilde{\gamma})\approx A(\gamma)K(\gamma-\tilde{\gamma})h(\gamma-\tilde{\gamma})B(\tilde{\gamma}) \quad (5)$$

[0029] Here, h() is a parallel kernel and A, B, and K are written as follows.
[0030] Front [convolution] load : [0031]
[Equation 15]

$$A(\gamma)=\frac{1+\cos^2\alpha\ \tan^2\gamma}{1+\tan^2\gamma}; \qquad (5a)$$

[0032] After [convolution] load : [0033]
[Equation 16]

$$B(\tilde{\gamma})=\frac{1+\cos^2\alpha\ \tan^2\tilde{\gamma}}{1+\tan^2\tilde{\gamma}}; \qquad (5b)$$

[0034] The kernel term by which multiplication is carried out to the expression about the parallel kernel h is written as follows.
[0035]
[Equation 17]

$$K(\gamma-\tilde{\gamma})=\frac{1+\tan^2(\gamma-\tilde{\gamma})}{1+\cos^2\alpha\tan^2(\gamma-\tilde{\gamma})}\times\left(\frac{\gamma-\tilde{\gamma}}{\sin\{a\tan[\cos\alpha\tan(\gamma-\tilde{\gamma})]\}}\right)^2 \qquad (6)$$

[0036] By replacing the transition change mold kernel g by above-mentioned transition eternal mold approximation, and substituting for a formula (8), the example of an exact third generation FDK algorithm is acquired.
[0037] Although it relates to the present multi-slice type scanner, in the example of useful others, the approximation which uses filtering as a transition eternal mold directly (therefore, convolution is made possible) is used for a small cone include angle [like]. This example is useful to fast mode. About a small include angle, convolution is simplified by approximating a fan beam parameter expression by the following formula.
[0038]
gamma t=gamma cos alpha (7)
Here, it is alpha=alpha (v, beta). Then, a reconstruction algorithm is written as follows.
[0039]
[Equation 18]

$$f(\mathrm{v})=\int_0^{2\pi}\frac{S}{L^2(\mathrm{v},\beta)}[g\otimes p^*](\gamma\ ;\xi',\beta)\frac{\cos^{3/2}(\gamma\cos\alpha)\,d\beta}{(\cos^2\gamma+\sin^2\gamma\cos^2\alpha)^{3/2}}, \qquad (8)$$

[0040] Or at the example of a half scan load, it is [0041].
[Equation 19]

$$f(\mathrm{v})=\int_0^{\pi+2\Gamma}\frac{S}{L^2(\mathrm{v},\beta)}[g\otimes(p^*\times HSW(\beta,\gamma))](\gamma\ ;\xi',\beta)\frac{\cos^{3/2}(\gamma\cos\alpha)\,d\beta}{(\cos^2\gamma+\sin^2\gamma\cos^2\alpha)^{3/2}} \quad (9)$$

[0042] It becomes. It is here and is [0043].
[External Character 9]
⊗は畳み込みを表わしており、

[0044] gamma is the maximum fan include angle of a fan beam, and S is the distance from a line source to an isocenter. v is the voxel in cylindrical coordinates (r, psi, kappa), and xi'=xi' (v, beta) is the height of the direction of z about the projection to the detector of v. L is the distance (in three-dimension space)

from the voxel to a line source, g() shows the fan beam reconstruction convolution kernel, P* is data after interpolating on the dip flat surface, and HSW shows the half scan load.

[0045] In order to process image data according to a formula (9), the X line source 14 moves in accordance with an orbit, and the cone beam 16 is projected on it toward the detector 18 which curved through the body or the patient 22 from the X line source 14. By the imaging system 10, the signal showing X-ray 16 detected by passing a body 22 is processed by DAS32, the imaging reconstruction machine 34, and the computer 36, and forms the fault image which appears in the CRT display machine 42. When using here, "the signal showing the detected X-ray" shall be interpreted widely. For example, the example using the parallel data line for detector component 20 and the example which multiplexes the data on a single line shall be included in transmitting a signal to DAS32 from a detector 18. Processing of the signal by the formula (9) includes applying a half scan load in advance of reconstruction filtering to the pretreated data. Although almost all curvilinear integrals are measured only once for these loads, some curvilinear integrals are coping with the data of being measured twice. Next, reconstruction filtering is performed as expressed by the convolution of g of a formula (9), and pxHSW. Next, back projection is performed in three-dimension space, compensating the X-ray cone shape of beam by adding the amount contributed from each projection to a given pixel. This back projection is expressed by the integral sum of a formula (9).

[0046] In the example useful in high-definition mode, interpolation of the projection data in alignment with the radii of cos (gamma) is excluded. Therefore, filtering of the projection data is carried out along with the line of a detector. Parameter expression approximation (8) is held.

[0047] Derivation of one example of the FDK algorithm of this invention which approximates FDK, without performing detector interpolation of cos (gamma) about the third generation CT imaging system 10 includes two approximation. Since the cone include angle is small to the 1st, these approximation is collapsed in it, and it is that filter processing is possible and that 2nd filtering of the data is carried out along with the line of a detector (that is, don't perform interpolation in alignment with the radii of cos (gamma)). Drawing 5 is geometric drawing of the fan shape of beam. All include angles and distance are based on the main flat surface of the gantry 12 which intersects perpendicularly with the z-axis. Voxel M is shown as what is projected on the main flat surface of a gantry 12. If reconstruction of the voxel M using the multi-slice type detector 18 is considered, as a result of modification of the configuration from a fan beam to a cone beam, the distance S from a line source to an isocenter will change to the distance St from a line source to the z-axis, and will be given by the following formula.

[0048] St=[S2+xi2] 1/2 -- here, xi is measured on the z-axis. Moreover, distance E=S+D (measured on the ray which passes along the z-axis) from a line source to a detector is Et. It is changed and is given by the following formula.

[0049] Et2= [E2+xit2]

Here, xit is measured on a detector 18.

[0050] When it starts with the two-dimensional reconstruction equation about fan beam data, it sets for the notation of drawing 5 and is [0051].

[Equation 20]

$$f(r,\phi)=\int_0^{2\pi}\frac{S}{L^2}\int_{-\Gamma}^{\Gamma} p^*(\beta,\gamma)g(\gamma-\tilde{\gamma})\cos\gamma \;\; d\gamma \;\; d\beta \qquad (10)$$

[0052] A next door, g(u) =(1/2) (u/sin u)2 h (u)

It comes out, and it is and h (u) shows the kernel in a parallel configuration here.

[0053] If a multi-slice type detector is used, a geometric configuration will change from a fan beam to a cone beam about reconstruction of Voxel M. As a result, the distance S from a line source to an isocenter is the distance St from a line source to the z-axis. It is changed and is written as follows.

[0054] St=[S2+xi2] 1/2 -- here, xi is measured on the z-axis.

[0055] Moreover, the distance (measured on the ray which passes along the z-axis) from a line source to a detector is E to Et. It is changed and is written as follows.

[0056] Et2= [E2+xit2]

Here, it is xit. It is measured on a detector.
[0057] Drawing 6 is geometric drawing of the third generation cone shape of beam which used the cylindrical shape detector 18. The ray 66 which has the cone include angle alpha to the flat surface of a gantry 12 is shown, and the flat surface of a gantry 12 is demarcated by Ox and y in drawing 6 . Moreover, the related ray 68 (it is in the same height on a detector 18) which passes along a revolving shaft z is also shown. Surrounding minute revolution dbeta of z is the surrounding angle of rotation dbetat of r. Angle of rotation dbetat which is equivalent It is written as follows.
[0058]
dbetat= [S/(S2+xi2)1/2] dbeta (11)
.
[0059] The fan include angle gamma in the flat surface (it intersects perpendicularly with z) of a gantry is fan include-angle gammat in a dip front face here. It is gammat= (E/Et) gamma=gamma cos (alpha) exchangeably. (being lower [of the upper assumption] strictly)
It becomes.
[0060] Therefore, [0061]
[Equation 21]

$$g(\gamma' - \tilde{\gamma}') = \left(\frac{E'}{E}\right)^2 g(\gamma - \tilde{\gamma}\ ). \qquad (12)$$

[0062] It becomes.
[0063] The load factor of the voxel dependency relevant to a configuration is determined. Since filter processing of the data is carried out along with the line of a detector, related xi which should be used for count of upper dbetat can be found about the given voxel M. therefore, xit =(EL) kappa -- it is -- xi= (S/E) xit it is -- supposing -- it is written as follows.
[0064]
xi=(S/L) kappa (13)
.
[0065] If all terms are doubled, the formula for a third generation FDK reconstruction algorithm will be written as follows.
[0066]
[Equation 22]

$$f(r,\phi,\kappa) = \int_0^{2\pi}\int_{-\Gamma}^{\Gamma} \frac{S}{L^2+\kappa^2}\frac{E'}{E} g(\gamma-\tilde{\gamma})p^*(\beta,\gamma,\xi)\cos\left(\frac{E}{E'}\ \gamma\right)\ d\gamma\ \ d\beta \quad (14)$$

[0067] The formula for the example of the corrected FDK algorithm is written as follows in alternative.
[0068]
[Equation 23]

$$f(r,\phi,\kappa) = \int_0^{2\pi}\int_{-\Gamma}^{\Gamma} \frac{S}{L^2+\kappa^2}\frac{1}{\cos(\alpha)} g(\gamma-\tilde{\gamma})p^*(\beta,\gamma,\xi)\cos\left(\gamma\ \ \cos(\alpha)\right)\ d\gamma\ \ d\beta, \quad (15)$$

[0069] Or at the example by an overscan load or under scan load, it is [0070].
[Equation 24]

$$f(r,\phi,\kappa)= \int_0^{2\pi+B}\int_{-\Gamma}^{\Gamma} \frac{S}{L^2+\kappa^2}\frac{1\times SW(\beta,\gamma)}{\cos(\alpha)} g(\gamma-\tilde{\gamma})p^*(\beta,\gamma,\xi')\cos(\gamma\cos(\alpha))d\gamma d\beta \quad (16)$$

[0071] It becomes. Here, B shows an overscan include angle and SW (beta, gamma) shows the load function which is either an overscan load function or an under scan load function. (In addition about an under scan, it is B= 0) .
[0072] In order to process image data according to a formula (16), the X line source 14 moves in

accordance with an orbit. The cone beam 16 is projected toward the detector 18 which curved through the body or the patient 22 from the X line source 14. By the imaging system 10, the signal showing X-ray 16 detected by passing a body 22 is processed by DAS32, the imaging reconstruction machine 34, and the computer 32, and forms the fault image displayed on the CRT display machine 42. Processing of the signal by the formula (16) includes a load to data, filtering, and back projection in this sequence, when SW (beta, gamma) is an under scan load function. Back projection is performed in three-dimension space, performing compensation about the X-ray cone shape of beam. When SW (beta, gamma) is an overscan load function, a load is dependent only on a line source include angle. In this case, projection data is acquired from 2pi over the range of a large line source include angle, and, thereby, the load is coping with the data that some curvilinear integrals are measured 3 times. Therefore, filtering is performed before a load and a load is performed before back projection.

[0073] In the one example, a FDK algorithm is fitted according to a spiral orbit. In a well-known multi-slice type CT system, almost all the imaging approach is a spiral type. Helical scan becomes possible by using correction that all the direction distance of z is computed to the main flat surface of a gantry. However, suitable attention must be paid for obtaining a number appropriate about each voxel in the image reconfigurated of data samples, and treating data redundancy. If at least two samples are given from a detector only using interpolation, a pitch will become very low and will become two per voxel thru/or three samples. On the other hand, it is nonpermissible by only canceling the 3rd sample to treat the inequality of a sampling from a viewpoint of the dosage to a patient. Therefore, in the one example, it makes it possible to raise a pitch relatively using an extrapolation, taking all projection samples into consideration. In order to treat data redundancy, the standard load technique is used. If it states clearly, HQ mode using this example will treat more samples than two per voxel, or this. The data redundancy from the 3rd sample is dealt with by using the overscan load or under scan load which graduates and removes the inequality of the data produced by the spiral orbit. In the example in HS mode, one per voxel or two samples are used. The data redundancy relevant to the 2nd sample is dealt with using the half scan load which carries out the feather ring of the inconsistency of the data produced with a spiral orbit and a cone include angle.

[0074] In the one example, in the case of 8 slice system, the pitch of 7:1 is used, and it is provided with the best cone artifact reduction measurement. The corrected FDK algorithm which is given by the formula (15) is used with correction of the addition which makes a gantry flat surface line source angular dependence. Moreover, back projection was extended using the overscan load from 2pi (8/7+epsilon) to x2pi. Here, epsilon is the parameter of the approach concerned. By using an overscan load, the inconsistency of the data in the embodiment gestalt of the spiral algorithm in the line source include angles 0 and 2pi relevant to motion of a patient's direction of z over a line source is avoided. (If IMEJINGU is performed without taking this inconsistency into consideration, a striped (streak) artifact will arise in the line source location direction of an include angle 0.) The useful overscan function contains what is written as follows.

[0075] f(x) =3 x2 -2x3 -- here, x changes between 0 and 1 at spacing considered. Moreover, [0076] [Equation 25]

$$f(x)=\frac{\left|\sin\left(\frac{\pi}{2}(1+x)\right)\right|^{\delta}}{\left|\cos\left[\frac{\pi}{2}(1+x)\right]\right|^{\delta}+\left|\sin\left[\frac{\pi}{2}(1+x)\right]\right|^{\delta}}$$

[0077] x changes between 0 and 1 at spacing considered here, and delta is a parameter.

[0078] In the one example, high pitch reconstruction is embodied by applying 1 / 2 scan load to the FDK algorithm with which the above-mentioned formula (8) was corrected. In other examples, back projection of the data is carried out on a three-dimension Descartes grid.

[0079] In the one example of this invention, the X line source 14 moves in accordance with the spiral

orbit over a body 22. The X-ray cone beam 16 is projected to the cylindrical shape detector 18 which curved through the body 22 from the line source 14. Processing of the detector data which form CT image in the imaging system 10 is performed by DAS32, the imaging reconstruction machine 34, and computer 36, and an image is displayed on the CRT display machine 42. This processing includes compensating the amount contributed which includes determining the amount contributed of the segment in alignment with the locus to the voxel in objective reconstruction volume, and was determined about the curvature of a detector, and the configuration of an X-ray cone beam. It includes that this decision performs filtering and back projection using the double integral about a fan include angle and a line source include angle for every point in reconstruction volume.

[0080] When stated with reference to the graph of the polar-coordinate reconstruction grid shown in drawing 7 , one example of this invention was embodied using the reconstruction performed on the polar-coordinate grid using MATLAB. The dimension of each shaft of drawing 7 is cm unit about this example. 41 in the line source location 70 of 984 places are shown. The reconstruction grid 72 by which the undershirt sampling was carried out is also shown. The image was interpolated on the Descartes grid using the 3rd interpolation call of MATLAB. A polar-coordinate grid is a suitable configuration for the third generation system which has a circular line source orbit. an include-angle grid increment equal to the include-angle increment of CT scanner 10 between views chooses -- having -- **** -- d theta=d beta=2 pi/Nviews it is -- since -- it becomes dr-dx. Here, dx is the dimension of the pixel of the last image. Thus, in the rim of FOV, the distance during the reconstruction lattice point serves as dx in approximation, and it decreases to zero at a core. The polar-coordinate grid simplified the program and enabled further preliminary count of all the trigonometric functions used for back projection.

[0081] R is the radius of a line source orbit and kdtheta expresses the line source include angle with drawing 7 . The pixel considered is located in the radius distance r and include-angle jdtheta. If this is borne in mind, it is comparatively simple to compute L which is the distance of a line source-pixel. The trigonometric function needed for computing such distance L is {cos (i dtheta)} about i= 0, ..., the (-one number of views). It is a chisel. The escape to three-dimension back projection is also simple, and it is L3d=(L2+dz2) 1/2. It is given. Effectiveness has also been improved when what the count of the floating point arithmetic (FLOP) of an algorithm decreases substantially if preliminary count is performed, and carries out back projection to all the lattice points near the zero avoids. (The alternative back projection to some points in a polar-coordinate grid increases the load of programming.) When stated with reference to the line source orbit shown in geometric drawing and drawing 8 of the third generation, the upper part or when it was located caudad, the zero-order extrapolation was used for the necessary data in the back projection of voxel actuation from 8 slice detector. For this extrapolation, the primary approach higher order than this or the approach by the polynomial was also able to be used. The line source orbit 74 and the detector front face 52 are illustrated. The reconstruction field is shown in the reference number 76. Half scan data were collected only between view include-angle - (pi/2+gamma) and + (pi/2+gamma). Since incidence of the ray 78 which passes along a point 80 in view include-angle - (pi/2+gamma) is not carried out to the front face 52 of a detector 18 about the spiral pitch exceeding Nslices/2, the extrapolation of the data of a ray 78 is carried out. However, the conjugation ray 82 collected in the view include angle 0 is always measured by the detector 18 about cone include-angle =0. In the one example shown in drawing 8 , it is the height =-zsourcex(R+D)/L - 1.06x pitch x slice width of face on the detector of R= 54.1cm, D= 40.8cm, FOV=48cm, gamma= 27.4 degrees, zsource= pitch x slice width-of-face x(pi/2+gamma)/(2pi), and kappa= ray.

[0082] It is clear from description of the more than related with various examples of this invention to draw simple deformation of data processing to which the example indicated here makes reconstruction more robust to a big cone include angle. Filtering of the data is carried out by "on-the-fly (on the fly)", and they add only slight deformation to a standard reconstruction processing chain. Probably, the example indicated here should be contrasted with adaptation-ization to third generation CT equipped with the cylindrical shape detector of a conventionally well-known FDK algorithm which cannot carry out filtering of the data which cannot cope with a configuration, therefore are not on the same flat surface. In addition, the example indicated here does not require the availability of the instantaneous

data about all the rays that pass the voxel about a given two-dimensional radon point which the well-known reconstruction approach of at least one others was demanding. The example indicated here utilizes the dosage to a patient thoroughly again, extending the imaging range of a patient. By utilization of an overscan load or an under scan load (respectively half scan load), an artifact is removed effectually, and thereby, if it combines with utilization of an extrapolation, in all imaging modes, utilization of a high pitch will become a actual target, without making dosage to a patient useless. The example indicated here offers the time resolution whose high speed used only few views relatively compared with at least one conventionally well-known 4 slice spiral reconstruction algorithm, therefore reconfigurated and improved. It will be understood by this contractor that the approach of this invention indicated here and the example of equipment give the balance in which allowance between improvement in image quality and practicability is possible in a third generation CT imaging system. furthermore, these examples --CT imaging -- it can embody within the limits of a limit of the constraint about the practicability imposed by the hardware of business, and the dosage to a patient.

[0083] Although it illustrated while describing the specific example of this invention in the detail, please understand clearly that they must not be interpreted as these meaning only explanation and instantiation and their being the things for definition. For example, the example of this invention is applicable to the detector of eight lines, 16 lines, or other line counts. Moreover, the example indicated here uses space interpolation of a detector about the given line source location. However, although the complexity in embodiment increases a little, the further improvement of the image quality in a small cone include angle can also be obtained by using the interpolation or the extrapolation of a conjugation ray to the cone include angle of zero. In addition, CT system indicated here is a "third generation" system which both X line source and a detector rotate with a gantry. If each detector component is amended and a uniform response is substantially given to a given X-ray beam, many of other CT systems including a "fourth generation" system which a detector is a quiescence type detector of a full ring type, and only X line source rotates with a gantry can be used. Therefore, the summary and range of this invention shall be limited by only a claim and its legal equivalent.

[Translation done.]

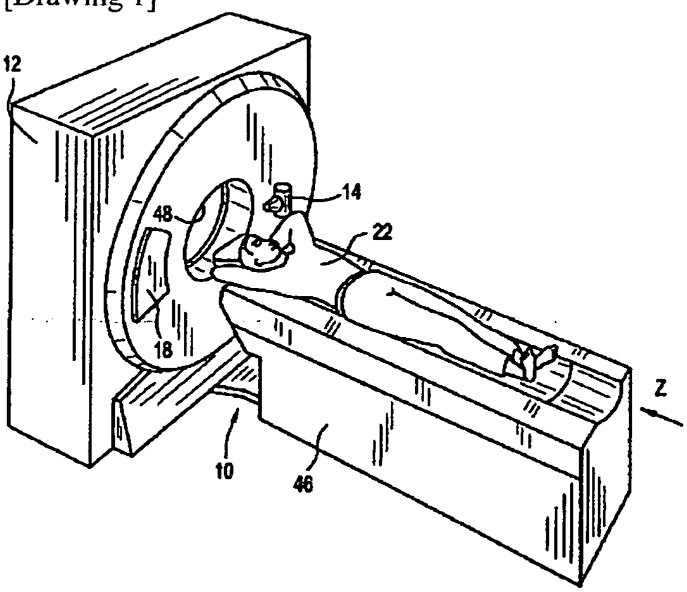
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sketch of CT imaging system.
[Drawing 2] It is the block schematic diagram of the system shown in drawing 1 .
[Drawing 3] It is geometric drawing of the example of a third generation 4 slice CT imaging system.
[Drawing 4] It is geometric drawing showing conversion in the geometric configuration of the third generation of the infinitesimal part of FDK.
[Drawing 5] It is geometric drawing of the fan shape of beam.
[Drawing 6] It is geometric drawing of the third generation cone shape of beam using a cylindrical shape detector.
[Drawing 7] It is the ~~graph of a~~ polar-coordinate reconstruction grid.
[Drawing 8] They are the geometric configuration of the third generation, and geometric drawing of a line source orbit.
[Description of Notations]
10 Calculating-Machine Type (Tomography CT) Imaging System
12 Gantry
14 X Line Source
16 X-ray Beam
18 Detector Array
20 Detector Component
22 Patient
24 Center of Rotation
26 Controlling Mechanism
28 X-ray Controller
30 Gantry Motor Controller
32 Data Acquisition System (DAS)
34 Image Reconstruction Machine
36 Computer
38 Large Capacity Storage
40 Console
42 Cathode-ray Tube Drop
44 Table Motor Controller
46 Motor Type Table
48 Gantry Opening
50 Z-axis
52 Detector Front Face
54 Ray
56 Cone Include Angle
58 Focal Spot
60 Radii
62 Ray
64 Ray
70 Line Source Location
72 Reconstruction Grid by Which Undershirt Sampling was Carried Out
74 Line Source Orbit
76 Field of Reconstruction
78 Ray
80 Point
82 Isocenter

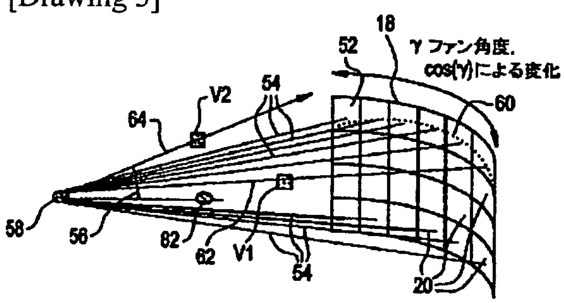
[Translation done.]

DRAWINGS

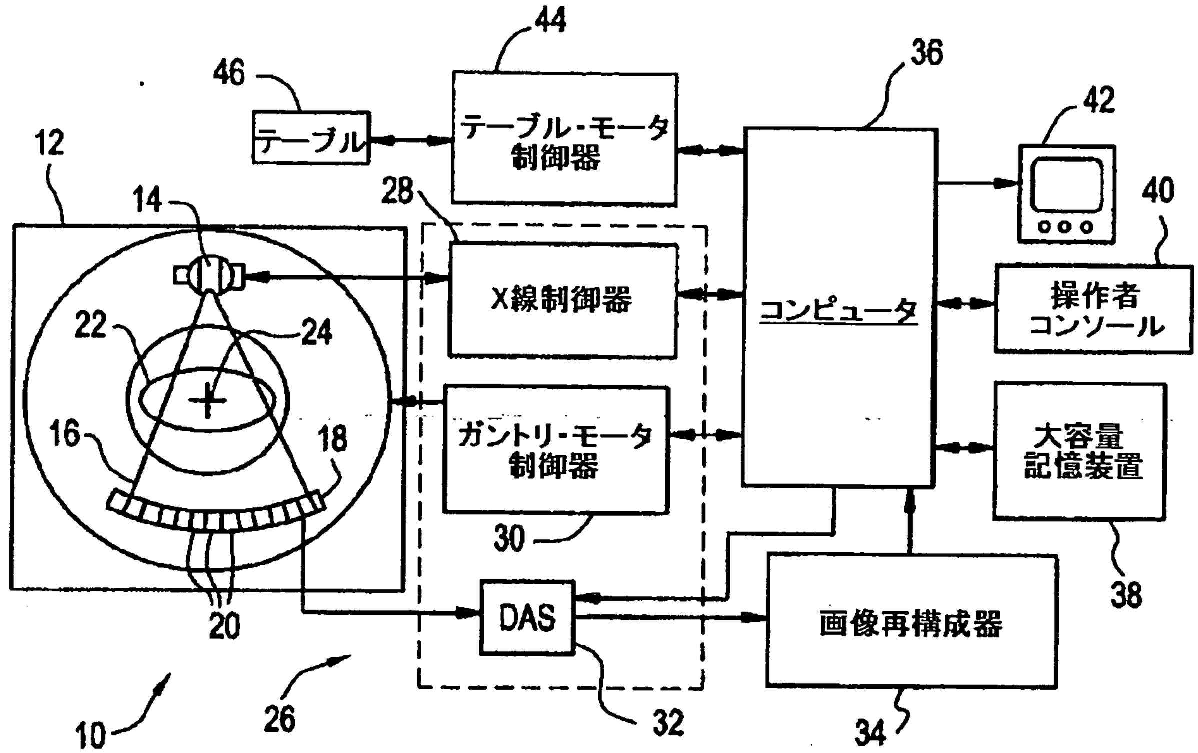
[Drawing 1]



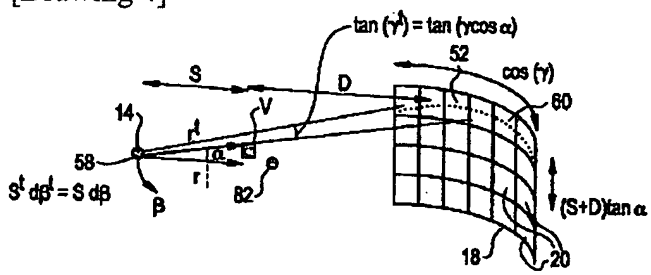
[Drawing 3]



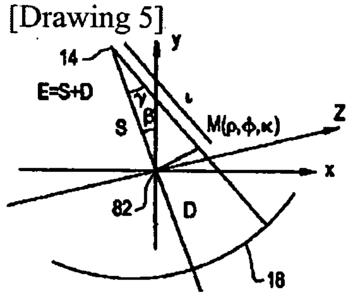
[Drawing 2]



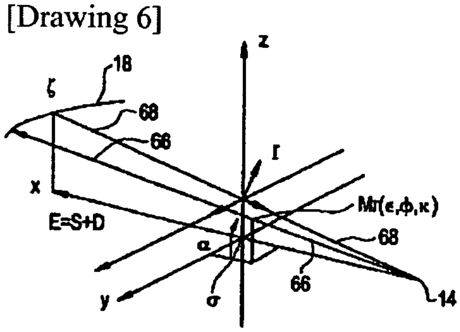
[Drawing 4]



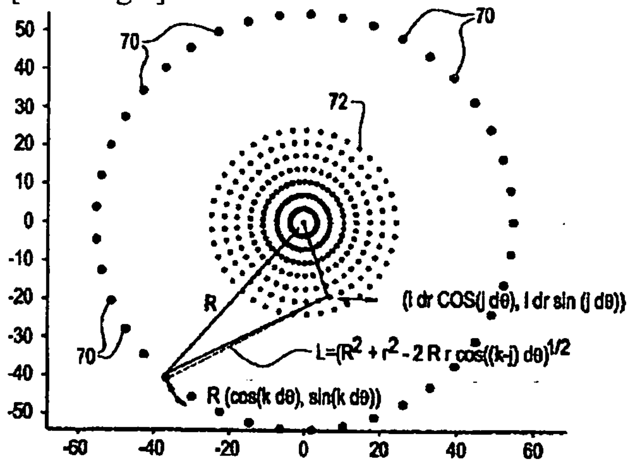
[Drawing 5]



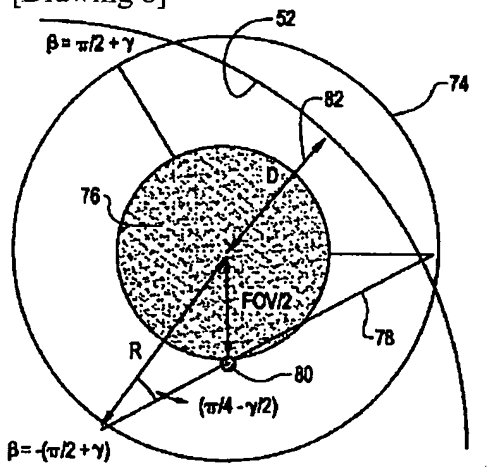
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]